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INSTRUCTIONAL APPROACHES FOR INDIVIDUALIZING BASIC RIFLE MARKSMANSHIP TRAINING

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Field tests such as the Basic Rifle Marksmanship (BRM) Test and the Laser/Rimfire Test have produced results that suggest BRM training is a viable candidate for individualization. It is unclear, however, what instructional strategies and organizational mechanisms are appropriate for accomplishing this individualization. Accordingly, a requirement exists for identifying the appropriate strategies for individualizing marksmanship training. This report presents the results of a review of the educational and training literature with respect to the individualization of training and discusses candidate mechanisms for implementing such training.

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FOREWORD

This report is provided by the Mellonics Systems Development Division of Litton Systems, Inc., to the Army Research Institute for the Behavioral and Social Sciences (ARI) under Contract Number DAHC 19-77-C-001. This report is part of the final report of the total research support effort and will be incorporated In that report by reference.

Under the contract, a part of Mellonics' effort concerns support to the Training Effectiveness Analysis (TEA) research presently being conducted by the ARI for the United States Infantry School (USAIS). One portion of the TEA research involves identification of improvements and the development of cost-effective alternatives for training M16A1 marksmanship. Field experimentation has suggested that basic rifle marksmanship (BRM) is a viable candidate for individualization of training. A need exists, however, to identify instructional and organizational strategies for individualizing this training. This report presents the results of a review of the educational and training research literature and is designed to identify instructional strategies for teaching BRM skills in an individualized setting and discusses candidate mechanisms for implementing individualized BRM training.

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ABSTRACT

Field tests such as the Basic Rifle Marksmanship (BRM) Test and the LASER/Rimfire Test have produced results that suggest BRM training is a viable candidate for individualization. It is unclear, however, what instructional strategies and organizational mechanisms are appropriate for accomplishing this individualization. Accordingly, a requirement exists for identifying the appropriate strategies for individualizing marksmanship training. This report presents the results of a review of the educational and training literature with respect to the individualization of training and discusses candidate mechanisms for implementing individualized BRM training.

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INTRODUCTION

The Basic Rifle Marksmanship (BRM) Test (1) and the Laser/Rimfire Test (2) have produced results that suggest rifle marksmanship training is a viable candidate for individualization. In these tests, basic trainees completed rifle marksmanship training programs designed to teach the operation and use of the M16A1 rifle. For selected groups of trainees in both tests, an early Record Fire (ERF) proficiency test was completed following the preparatory marksmanship phase of BRM training. This proficiency test was similar to the Record Fire test normally completed after the Record Fire preparation phase of training. For both the BRM and the Laser/Rimfire Tests, analysis of trainee firing performance for the ERF test revealed that a significant proportion of trainees achieved or exceeded the minimum standard for BRM qualification. This result indicates that some trainees may not need to complete the full rifle marksmanship training program in order to qualify in the operation and use of the M16A1 rifle. For this reason, it is appropriate to consider the possibility of individualizing BRM training. The purpose of this individualized program would be twofold:

o First, to identify those trainees who can qualify
early in training and provide training that capi-
talizes on their demonstrated marksmanship profi-
ciency.

o Second, to identify those trainees who cannot
qualify early in training and determine through
appropriate tests their skill weaknesses. For
these personnel, training designed to correct
identified weaknesses would be provided in order
to maximize the likelihood of BRM qualification
following this training.

Strategies for implementing an individualized BRM training program have not been developed. Accordingly, a requirement exists to identify instructional mechanisms for the individualization of BRM training. For this reason, a review of the educational and training literature was conducted to identify instructional strategies for teaching BRM in an individualized setting. Based on the results of this review and relevant considerations for BRM training, organizational mechanisms for implementing an individualized BRM training program were identified. This report presents the results of the literature review and discusses the candidate mechanisms identified for implementing individualized BRM training.

OBJECTIVES

The objectives of this research are:

o To identify and describe alternative individualized teaching strategies and discuss the potential advantages of these strategies for BRM training.

o To identify and outline strategies for organizing and managing the flow of trainees between and within the various phases defining BRM training.

METHOD

The identification of instructional and organizational strategies for individualizing BRM training was accomplished in the following way. First, the educational and training literature was reviewed to identify alternative concepts and instructional strategies for the individualization of the perceptual and motor skills training required during instruction in BRM. Next, based on the results of this review and relevant considerations for current BRM training, organizational mechanisms for implementing an individualized BRM training program were derived. Finally, these results were assessed and conclusions derived for developing an individualization BRM program.

LITERATURE REVIEW

A number of theorists have recently suggested that a prescriptive science of instructional strategies can be developed at the present level of theoretical understanding (3,4,5). Although not new (6,7), such a development would be a major improvement beyond accidental instructional strategy selection - which remains the usual situation in current military training programs. Adequately developed techniques for applying systematically selected instructional strategies to Army training programs appear to be one reasonable method for improving existing training.

One such technique is individualization of instruction. According to a recent review on this topic (8), a variety of benefits accrue from individualization: These include:

o Students are engaged in activities which they are capable of performing at virtually all times.

o Students enjoy a relatively high frequency of successful learning experiences, thereby sustaining motivation to learn.

o Students are protected from experiencing an overwhelming number of failures.

o Material is presented at a pace which can be assimilated by the individual student.

o Review of material is easily accommodated.

o Previously learned habits are brought to maximum strength before new habits are introduced.

o Mastery of material is required for program completion.

In this review four basic ingredients of individualized instruction (in terms of the products required for individualization to be successful) are specified:

o Behaviorally stated objectives;

o Criterion-referenced tests for evaluating the attainment of specific objectives by individual students;

o Learning activities and materials for facilitating the attainment of objectives, each requiring a minimum amount of teacher intervention;

o A record-keeping system for managing the progression of individual students through the various learning activities.

Individualization in instruction, however, need not occur all at once, but can proceed progressively through several different levels. At the simplest level, students may progress at individual rates through a fixed set of objectives and learning materials. At higher levels, students may be offered options in sequence, in media, in content vehicle, or in various combinations of these features. Finally, at some ultimate level, students may be allowed options in the objectives that they seek to attain. Butler (9) has judiciously pointed out certain cost implications of individualization:

"Although self-study situations place the content and pace of the instruction almost entirely under the control of the individual student, group-paced instructional systems adapt to individual needs to a considerable degree. Ideally, of course, the more the instruction is "individualized" the better; however, there are practical considerations that impose limits on how far the designer can go in that direction. The more the instruction is individualized, the more expensive it is in terms of manpower, time, equipment,

facilities, and materials, both while the system is
being developed and while it is being used. Completely
self-paced instruction is usually more expensive for
the very reason that it is more effective than group
instruction - each student must have his own material,
equipment, facilities, and individual tutoring when
he needs it, not when it can be scheduled for adminis-
trative convenience, nor to accommodate to the group"

In this portion of the report, concepts relevant to the feasibility
of individualizing BRM training are reviewed. In particular, alterna-
tive concepts and instructional strategies for the individualization of
the perceptual and motor skill training such as that required in BRM are
addressed. This review will restrict itself to the third of Whitmore et.
al.'s (10) four ingredients of individualized instruction listed previously
(i.e., a discussion of instructional strategies). The remaining three
ingredients, while critical and of documented importance, are beyond the
scope of the review.

THE ABILITIES APPROACH

In a series of studies by Fleishman and his associates (11) the theory
has been raised that skill learning, particularly motor skill learning,
is meditated by a theoretical construct termed "ability." In Fleishman's
view, the term "skill" refers directly to a level of proficiency on a
specific task. Skill proficiency thus suggests direct proficiency in task
oriented situations such as flying an airplane. The term "ability," on
the other hand, refers to a more general trait which has been inferred
from response consistencies on certain comparable kinds of tasks. Ability
thus is a construct, or trait, which although difficult to measure, is
presumably highly correlated with skilled performance. According to this
view, abilities depend to great degree, upon genetic (as opposed to
learning) factors.

Fleishman and his associates have established a large literature on
ability-skill correlation. The basic theory is that whereas adults show
learning over time in practically any type of skill; the rate of that
learning, and the final level achieved by participants are limited by the
basic abilities of the individual. Further, the theory postulates that
basic abilities are themselves relatively stable and thus are of use in
predicting performance on specific tasks.

Fleishman and his associates have devoted a great deal of effort to
the study of specific human motor abilities including such aspects as:
fine manipulative performance, gross physical proficiency, positioning
movement, static relations, etc. This work has revealed a tentative tax-
onomy of human motor abilities (12). Nineteen abilities are called out
by this taxonomy. They include: control precision, multi-limb coordina-
tion, response orientation, reaction time, speed of arm movement, rate
control, manual dexterity, finger dexterity, arm/hand steadiness, wrist/

finger speed, aiming, extent flexibility, dynamic flexibility, static strength, trunk strength, gross body coordination, gross body equilibrium and stamina.

As regards rifle marksmanship, it appears that two of these abilities are preeminent: control precision and aiming. Control precision is a factor common to tasks which require fine highly controlled muscular adjustments including arm and hand movements. Aiming (or eye-hand coordination) is, according to Fleishman, defined by the ability of students to place dots in very small circles as rapidly as possible, under severe speed stress.

Fleishman's approach to training in motor skill areas advocates experimantal investigation of the basic abilities underlying the requisite skills, and a training program aimed at tutoring subjucts in the relevant abilities. This has been shown effective in a variety of studies (13,14, 15). Fleishman's work is aimed primarily at the identification of relevant individual differences among trainees in terms of their abilities and at the development of training programs around these individual difference characteristics.

STRUCTURED VERSUS DISCOVERY LEARNING APPROACHES TO INSTRUCTION

A theoretical dichotomy in the area of skill acquisition and instruction involves the disparity between proponents of highly structured, directed, and guided approaches to skill learning (such as Gagne and Skinner) and the experiential, or discovery learning, approach championed by Brunner (16). Gagne (17) has presented a comprehensive model for guided learning. This model suggests that the prerequisities for learning are connected to each other hierarchically. Learning can best be accomplished by a guided, step-by-step instructional sequence through the hierarchy, according to this model. Careful sequencing and prompting of instructional material characterize Gagne's approach.

Within this framework, an approach known as "command learning" (18) has been successfully applied to instructional situations in the physical education area. The command technique is associated with structured, formal learning strategies and specific task-oriented guidance. Command learning is considered to be behavioristic and often involves the use of programmed material.

In contrast, discovery learning allows the learner to experiment and to explore problems and situations. Material to be learned is presented in the form of a problem. The learner is encouraged to discover the way to achieve the desired result(s). In the physical skill area, a form of discovery learning, termed "movement exploration," is becoming increasingly popular. This, like the Fleishman approach, emphasizes the teaching of basic movement patterns rather than of specific perceptual-motor acts. Following a major review of literature on this topic, Singer (19), has concluded that prompted or guided techniques are superior to discovery

learning for initial cognitive tasks. This is presumably the case because, using this approach, specific skill errors are minimized. It has been adequately demonstrated that the effect of response errors on motor skill learning is devastating (20). Discovery training, Singer has concluded, is effective for transfer and or retention of skilled learning if adequate time is alloted for appropriate processes to be developed, and if the learning experience of the student is a successful one.

In psychomotor learning (as opposed to cognitive learning), however, the serious advantage of the structured, guided approach may be obviated. Mistakes in psychomotor learning may well be "necessary evils," as suggested by Singer (21). One relevant way to learn appropriate movement is through experience with inappropriate movement. However, in a series of extensive studies conducted by Prather and his associates (22) heavily prompted learning lead to significant advantages over trial and error learning in early trails on a complex perceptual-motor skill (i.e., range estimation). Prather, Berry, and Bermudez (24), have found that extrinsic feedback, as is typically delivered in guided instructional techniques, produces better learning than does comparable trial and error methods.

It appears thus, that guided learning is generally more effective than is trial and error learning in activities which require fixed responses to fixed cues. However for activities which make varied and unpredicable demands upon an individual, guided practice must be supplemented by instructional strategies which allow for adaptation to widely varying demands. Having reviewed the literature, Singer (25), concludes that no one instructional strategy is consistently appropriate. However, five parameters for choosing instructional strategies in motor skill contents have been put forth. These are:

o If the performance of learning a skill is only for
   the highest level of performance in that skill, then
   a guided and prompted method of learning would seem
   to be the appropriate choice-especially if there is
   concern for economy in training time.

o If the purpose of the learning situation is to lead
   to the application of what has been learned for
   transfer to other related skills and situations, it
   would seem that some form of discovery, problem
   solving, or trial and error strategy should be em-
   ployed.

o Self-paced, closed loop tasks should be learned
   primarily through a guided technique for response
   consistency.

o Externally paced, open loop tasks should be learned
   primarily through a discovery technique for famili-
   arity with diverse situations and response adapta-
   tions.

o The later learning situation should be consi-
    dered and might determine what the prior
    learining methods should be, e.g., if subse-
    quent experiences are going to occur with the
    availability of prompts and guides, then it
    would seem to be a waste of time and effort
    to conduct the initial learning experience
    under a discovery method.

The major conclusion is that the benefits of discovery learning or
problem solving are most effectively utilized in situations where a great
deal of adaptivity and a broad assimilative set are required. Guided or
prompted learining, on the other hand, is best utilized in more structured
situations resulting in narrow requirements for subject assimilation.

OTHER THEORETICAL APPROACHES

Welford (26), in a monumental work on skill acquisition, has suggested
that the durability of learning is much firmer and more resistent to extinc-
tion in motor contexts than in cognitive ones. Having reviewed the litera-
ture on the question whether information provided in training about a
given task should concentrate on general principles or, alternatively, de-
tail rules of procedure, Welford determined that the research findings
suggest that for complex tasks instruction in principles yields better
results than does laying down a detailed, repetitive drill type of instruc-
tion. For simpler tasks, the drill approach is at least equally effective.
The reason, as suggested by Welford, is that a complex task commonly
involves a number of alternative sequences of actions, each appropriate
to particular varieties of a circumstance under which a task is carried
out. Attempts to reduce this to drill type learining, will require
at best, that a variety of drills be learned. This in turn introduces
competition and ambiguity amoung the components of learning. Welford
has suggested that the predomination of initial experience is important
in skill learning situations. This has been affirmed through studies
(27,28). First experience, thus, is seen as being very important in skill
learning contexts.

The theory behind this approach, is that experience is presumably
bound up with the cumulative nuture of learning. When a person encounters
an entirely new problem, he must construct his solution from past experience
dealing with different problems. Once he has done this an outlined method
exists for use in dealing with similar problems on subsequent occasions.
Even if the constructed method is not the best possible, it is generally
more efficient than it would be to work out new methods for each possible
situation in skill learning.

Welford has suggested that very little learning occurs when the stu-
dent is a passive spectator (or even a passive performer). The student
must be involved in active decisions and choices about what he is doing,
in order to retain information about alternative strategies which are right
or wrong in various skilled performance contexts. Welford's review of the

literature on knowledge of results of actions, and on aims and incentives, concluded that, other things being equal, the more precise the knowledge given of the results of action, the more accurate the actions will become over a series of trials. As regards incentives, Welford suggested that speed of learning is substantially influenced by relevant incentives (including as one type of incentive, the effect of knowledge of results).

APTITUDE/TREATMENT INTERACTION STUDIES

The effects of individual aptitudes on learning strategies and the interaction between these two phenomena on complex performance is currently a very popular topic in skill learning. Reviews by Bracht (29), and by Cronbach and Snow (30), have indicated that the overall effects of aptitude/ treatment interactions on skill learning are minimal. According to a review by Maxey (31), the following conclusions are warrented:

o Few or no individual difference/treatment interactions have been solidly demonstrated.

o The frequency of studies in which disordinal interactions have been found, is low.

o The empirical evidence is often not convincing in studies that do claim to show such interactions.

Tallmadge and Shearer (32), have suggested that "despite the evidence of some apparent consistency in the research literature, an overview would certainly uncover more negative than positive findings, and more inconsistencies than consistencies" on aptitude/treatment interactions. Similarly, according to Maxey (33), the comparative literature on programmed instruction versus other instructional methods is equally nebulous. When taken together, it is suggested that approximately 50% of the reviewed studies found that programmed instruction was associated with superior post-instructional criterion performance. In general, the remaining 50%, found that there were no differences in post-instructional performance of programmed and conventionally instructed students. This is consistent with the findings of Pieper and Swezey (34), and of Pieper, Catrow, Swezey, and Smith (35). One theory as presented by Swezey (36), has suggested that degree of learner concentration may be an appropriate mediating variable in perceptual/motor skill learning contexts. Degree of subject concentration may also be manipulable by training designers, by varying the relative difficulty of the instructional material presented to subjects during the training sessions.

PHASES OF SKILL LEARNING

In a major treatise on learning skilled, Fitts and Posner (37), have suggested that skilled learning is essentially a three stage process. The first phase is generally a cognitive phase, in which the student attempts

to understand the task and its demands. In this stage, attention to perceptual cues and response characteristics, and knowledge of results as a training strategy are important. Attention to various kinesthetic and visual aspects of the task, is important in the cognitive phase of skill learning. Here, instructions and demonstrations, as well as structured programmed techniques, are appropriate.

The second stage of skilled learning, according to these authors, is the intermediate or associate phase. During the intermediate phase of skill learning, old habits which have been learned as individual units during the early phase of skill learning, are tried out and new patterns begin to emerge. Errors (grossly inappropriate subroutines, wrong sequences of acts, and responses to the wrong cues), which are often frequent at first, are gradually eliminated. This phase lasts for varying periods of time, depending on the complexity of the skill and extent to which it calls for new subroutines and new integrations.

During the second stage, proper scheduling and sequencing of practice on the component aspects of the task are important. For example, Koch (38), asked subjects to type finger exercises, using two typewriters simultaneously. The groups that began by practicing with each hand separately before attempting to use both hands simultaneously made faster initial progress and maintained this superiority when they went on to practice the two-hand task than did the groups that began by using both hands. This result clearly favored training in the separate components to training for the whole task from the start.

The following instructional principle is set forth by Fitts and Posner for phase two learning:

> "If the components of the skill are independent of
> each other, such as the typing of different passages
> with separate hands, then it is better to practice
> each component separately....When, however, the
> task involves synchrony between the components,
> such as in playing the piano or reciting a meaning-
> ful passage, much of the learning is concerned
> with the overall integration of the components and
> thus, is best learned as a whole."

The final stage of skilled learning, according to Fitts and Posner, is the so-called "autonomous" phase. During this phase of skill learning, component processes become less directly subject to cognitive control, and therefore, less subject to interference from other ongoing activities. In this phase, skills required less processing. This means that they can be carried on while new learning is in progress or while an individual is engaged in other perceptual and cognitive activities. Appropriate training strategies for this stage, suggest that practice not only renders an activity less susceptible to interference from a second task but permits the subject to allocate more of his capacity to the second task, thus, indirectly enhancing performance on that task as well.

BRM TRAINING

Reviews by Smillie, Klein, and Bercos (39), and by Smillie and Chitwood (40), report that the objectives of M16A1 BRM training are to cause soldiers to:

o Develop the confidence, will, knowledge, and skills required to fire the weapon and hit the enemy in combat.

o Acquire the ability to apply correct techniques of rifle marksmanship when functioning as an individual in a unit engaged in combat.

o Maintain a continuing degree of proficiency in combat, consistent with the mission of the unit to which the student is assigned.

o Properly maintain the weapon.

o Provide a peacetime force of shooters which will make available a potential group of precision marksmen for interservice, civilian and international competition.

o Provide a wartime instructor base, or cadre, for sniper training where required.

Current BRM training programs have been throughly described and differences across training sites indicated, in a recent work by Rosen and Behringer (41). These authors have concluded, among other things, that:

o Current BRM training criteria do not meet required combat characteristics.

o Moving targets should be used in BRM training.

o Training conditions are unrealistic.

o Current training methods and procedures provide for teaching the skills required for individual soldiers to meet the current standards, but not necessarily in the best way.

o A significant gap exists between current standards and conditions and those required.

Rosen and Behringer have recommended that revised BRM training criteria (including revised standards and conditions) be implemented, and that a moving target system be designed and included in BRM training.

SUMMARY

In summarizing the findings of this review as they relate to BRM training, the following conclusions are warranted:

o Group based, structured, prescribed and programmed instructional methods (such as the Army's Training Extension Course - TEC) should be considered for training soldiers in the cognitive and/or procedural aspects of BRM training (i.e., strategy and tactics, equipment maintenance, assembly, disassembly, armored vehicle and other target recognition, and nomenclature.

o For those aspects of BRM training which include actual rifle firing, guided or prompted learning strategies should be considered for development.

o The recommendations put forth by Rosen and Behringer (42), specifically those including the combat referencing and threat orientation of criteria for BRM training, should be seriously considered for adoption.

o A two-phased BRM training program should be considered for adoption. This program would consist of a series of prescribed, programmed learning sequences (possibly TEC lessons, or other individual or group paced methods of instruction) for the knowledge oriented and procedurally oriented components of BRM training. This phase would be followed by a hands-on, prompted learning instructional method for the actual rifle firing aspects of the program.

o The precise time split between the two phases of the proposed BRM program remains to be determined on the basis of practical considerations.

STRATEGIES FOR ORGANIZING AND MANAGING AN INDIVIDUALIZED BRM TRAINING PROGRAM

In the previous section of this report, the results of a literature review designed to identify instructional strategies for teaching BRM were presented. Conclusions relating to BRM training were also presented. In this section of the report, candidate mechanisms for implementing an individualized BRM training program are presented and discussed. Preliminary to

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this, it is appropriate th discuss the nature and conduct of current BRM training, its relationship to the overall Basic Combat Training (BCT) program, and the nature of BRM training as it is likely to be practiced in the future by the U. S. Army.

Current BRM Training. Up until the Spring of 1977, BRM was conducted according to the guidance provided by the Army Subject Schedule 23-72 (43). At this time a revised BRM program was put into effect. This program, known as the Fort Benning program, requires 37 hours and 334 rounds of 5.56mm ammunition for completion (44). Table 1 summarizes the training and evaluation activities conducted during completion of this program, as well as the hours and rounds required for each activity.

The first phase of training in the Fort Benning program involves an orientation to the subject of rifle marksmanship which is followed by instruction and practice activities designed to teach the nomenclature of the M16A1 rifle, its assembly and disassembly, its functioning, immediate action procedures for stoppages, loading and unloading both the rifle magazine, M16A1 maintenance, and rifle ammunition. This training is usually conducted in a classroom. In this phase there are no ammunition requirements since the rifle is not fired during the training. Training success is measured by a performance test designed to determine how accruately and quickly the trainee can disassemble, assemble, and perform immediate action for the M16A1 rifle.

The next phase of training, Preparatory Marksmanship, involves teaching the trainees the skills required to orient and fire the rifle so that accurately placed hits are high probability events. Trainees learn to perform the following tasks:

        o Align the front and rear sights;

        o Place the aiming point in the appropriate
           relation to the front and rear sights;

        o Hold the rifle steady during firing;

        o Use proper trigger control and followthrough;

        o Assume designated firing positions;

        o Adjust M16A1 sights.

This training is conducted on a 25-meter firing range. Successful completion of this training phase occurs once the trainee is able to battlesight the M16A1 rifle.

Following the preparatory phase of instruction, the trainee initiates the Record Fire Preparation training phase. This training is designed to provide the soldier with an opportunity to extend the application of rifle

Table 1

NUMBER OF PERIODS INCLUDED IN AND DISTRIBUTION OF HOURS AND ROUNDS ACROSS THE
TRAINING AND EVALUATION PHASES DEFINING THE FORT BENNING BRM PROGRAM

Phase	Number of Periods Included in Phase	Hours Allocated to Phase	Rounds Allocated to Phase
Training			
Orientation and Mechanical Training	1	4	0
Preparatory Marksmanship	3	10	42
Record Fire Preparation	3	12	118
Automatic Rifle Firing	1	3	45
Total Training	8 Periods	29 Hours	205 Rounds
Evaluation			
Day Record Fire	1	5	40
Night Record Fire	1	3	89
Total Evaluation	2 Periods	8 Hours	129 Rounds
Total Program	10 Periods	37 Hours	334 Rounds

marksmanship fundamentals to more complex, more demanding conditions than those encountered during the preparatory phase. For this reason there is little emphasis on the acquisition of new skills. Instead, the trainee practices engaging single and multiple targets that appear for brief intervals of time (5 to 20 seconds) located at short (50 to 100 meters), medium (150 to 200 meters), and long (250 to 300 meters) target ranges. This training is conducted on Field Fire ranges. Training success is measured during the completion of the Day Record Fire marksmanship evaluation.

The Day Record Fire evaluation is completed after the Record Fire Preparation training phase. This evaluation consists of a series of firing trials. Each trial is defined in terms of the position from which firing is conducted, the number of targets available during the trial, the distance of the targets from the firer, and the amount of time available for target engagement. Table 2 summarizes the distribution of rounds of live ammunition fired during the Fort Benning Record Fire evaluation. As shown in the table only two firing positions are employed during the evaluation (the foxhole and prone unsupported positions). The number of hits achieved during the evaluation constitutes the trainee's score. To qualify in the use of the M16A1 rifle, the trainee must obtain 17 or more hits after firing the Record Fire exercise.

If less than 17 hits are obtained, the trainee is allowed to refire the exercise until a score of 17 or better is achieved. If the trainee cannot achieve the minimum score after several attempts, he is either recycled or, at the discretion of the local commander, the minimum requirement is waived.

After the Day Record Fire evaluation is completed, trainees complete the Automatic Rifle Firing phase of training. This is conducted at a 25-meter firing range. In this phase, the trainees are taught the use of the automatic mode of the M16A1 rifle. Tasks covered during instruction include the following:

        o Aiming the rifle while firing in the automatic mode;

        o Holding the rifle steady in the automatic mode;

        o Assumption of the bipod supported prone position;

        o Changing the rifle magazine rapidly;

        o Fire distribution.

Some of this instruction is conducted prior to this phase, concurrently with the Record Fire evaluation. The bulk of the instruction, however, occurs during the time allocated for this phase of instruction. After the automatic rifle fire instruction is completed, a practical exercise in firing the M16A1 rifle in the automatic mode is completed. In this exercise,

Table 2

DISTRIBUTION OF FIRINGS IN ROUNDS OF LIVE AMMUNITION BY FIRING POSITIONS,
TARGET TYPE, AND TARGET RANGE: DAY RECORD FIRE, FORT BENNING BRM PROGRAM

Phase	Target Type	Target Range		
		Short[a]	Medium[b]	Long[c]
Foxhole	Single	3	4	5
	Multiple	3	2	3
Prone Unsupported	Single	1	1	2
	Multiple	5	6	5

a   50 or 100 meter target ranges

b   150 or 200 meter target ranges

c   250 or 300 meter target ranges

45 rounds are fired against standard 25-meter automatic rifle targets. This phase is completed once the practical exercise has been fired. There are no minimum success requirements that trainees must meet in order to successfully complete the firing exercise.

The final phase of the Fort Benning program is the Night Record Fire evaluation. It is completed after the Automatic Rifle Firing phase of training on a Night Record Fire range. Trainees are first given an orientation to the evaluation and the principles of night vision and the night fire pointing techniques are explained. Next, the Night Record Fire evaluation is completed. This includes the following firings:

- o Practice fire 3 rounds at 25-meter targets, semi-automatic mode;

- o Record fire 10 rounds at 25-meter tartets, semi-automatic mode;

- o Practice fire 3 rounds at 25-meter targets, automatic mode;

- o Record fire 30 rounds at 25-meter targets, automatic mode;

- o Record fire 10 rounds at 50-meter tartets, semi-automatic mode;

- o Practice fire 3 rounds at 50-meter targets, automatic mode;

- o Record fire 30 rounds at 50-meter targets, automatic mode.

To successfully complete this evaluation the trainee must obtain 20 hits to be classified as a "GO" on the evaluation. Refires in this phase of the program are allowed until the success criterion is met or it is judged that the trainee is not likely to be able to meet the minimum requirement. In the latter case, the trainee is either recycled or the requirement is waived by the local commander. Completion of this phase of the program constitutes completion of the total Fort Benning BRM program.

Basic Combat Training. Each individual entering the U. S. Army receives basic combat training (BCT) in the case of males and basic training (BT) in the case of females. The purpose of this training is the following:

- o to teach the use of a weapon;

- o to teach the fundamentals of soldiery;

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o to teach the responsibilities of soldiers under
   the international body of law governing warfare;

o to physically condition the trainee (45).

BCT and BT are conducted at Army Training Centers. Upon arrival at a
training center, the individual is processed and assigned to a basic
training company. Unless the trainee is recycled at some time during
the BCT or BT program, he (or she) remains assigned to this company for
the entire BCT or BT program.

During basic training, the company is responsible for insuring that
the trainee completes all aspects of the BCT or BT program. In addition,
the company is responsible for all other aspects of the trainee's mili-
tart life, e.g., maintenance of records, pay, clothing, and food. For
this reason, the company is the primary managerial unit during basic
training. Therefore, any plan to individualize some or all aspects of
the basic training program must take into account the company-trainee
managerial relationship.

Currently, basic training is an eight week, 337 hour program (46).
As discussed previously, 37 hours of this time are allocated for BRM
training. Normally, BRM instruction is initiated during the second
week of the basic training cycle. At this time, trainees complete the
orientation and Mechanical Training phase of the program. Then, during
the third and fourth weeks of basic training, the remaining phases of
BRM training are completed. The conduct of these training and evalua-
tion activities are dependent upon the availability of ranges and the
requirements for other basic training activities that are ongoing
during this time. Thus, any plan to individualize BRM training that
requires additional use of ranges and that may impact on the completion
of other basic training activities must take these factors into
account.

BRM Training in the Future. The nature of BRM training in the U. S.
Army is currently in flux. The BRM training program now in effect is
considered to be an interim program. In the future, it is planned to
augment the current program with training designed to instruct trainees
in the knowledges and skills required to engage moving targets and pro-
vide practice opportunities for engaging such targets. Additionally, it
is planned to change the post-training daylight marksmanship evaluation
to include briefly appearing, single and multiple moving targets located
at various target-to-firer ranges. The basic rationale for these
changes is the acknowledgement that on the battlefield, the rifle-engage-
able threat consists not only of stationary targets, but also, of moving
targets. As a consequence, the BRM program of the future will likely
consist of the following phases:

o Mechanical training to teach rifle nomenclature,
   rifle functioning and the disassembly, assembly,
   and immediate action procedures for the rifle;

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o Fundamentals training to teach the skills required
  to hold, sight,and fire the rifle so that accurate-
  ly placed target hits can be achieved;

o Stationary target engagement training to teach the
  skills required to engage single and multiple sta-
  tionary targets located at short, medium, and long
  target ranges under conditions of time pressure;

o Moving target engagement training to teach the
  skills required to engage single and multiple
  moving targets located at short, medium, and
  long target ranges under conditions of time pres-
  sure;

o Automatic and night rifle firing training to teach
  the use of the automatic mode of the M16Al rifle
  and the engagement of targets (both stationary and
  moving) under reduced illumination level conditions;

o A qualification evaluation designed to evaluate the
  post-training capabilities of the trainee to engage
  single and multiple targets (both moving and sta-
  tionary) under conditions of time pressure during
  high (day) and low (night) illumination levels.

As discussed in the introduction to this report, it is possible that
individualizing such a marksmanship program might be appropriate. Depend-
ing upon how this is accomplished, certain benefits may accrue to the
trainee:

o Trainees who can demonstrate satisfactory pro-
  ficiency with respect to some or all aspects of
  BRM training may be singled out for special
  training or be excused from BRM training to
  complete training in other skill areas taught
  during basic training.

o Trainees who are unable to achieve satisfactory
  proficiency levels with respect to selected BRM
  content areas may receive diagnostic testing
  designed to discover the basis for their unaccep-
  table proficiency levels. Then, based on the re-
  sults of this testing, these trainees could com-
  plete training specifically tailored to meet their
  particular performance weaknesses.

o Trainees who are only marginally capable of per-
  forming BRM tasks in some or all aspects of BRM
  training may be identified and receive a specif-
  ic remedial course of BRM instruction designed to
  bring the trainee up to a satisfactory proficiency
  level.

In the remaining part of this section of the report, several strategies for individualizing BRM training that provide for the above described benefits are discussed in terms of the requirements for implementing these strategies and their likely impact on the interface between BRM training and the other instructional requirements of basic training.

Individualization of BRM Training. McFann (46) discusses four types of instructional systems and their implications for the individual-ization and management of training. These are summarized in Table 3. For Strategy I, trainees enter together, receive a standard program of instruction, and finish together. Trainee proficiency is measured with respect to a scale of measurement that varies from a low to a high level. To graduate, trainees must achieve post-training evaluation scores that equal or exceed some minimum value. Administratively, this strategy is appealing because of its ease of implementation. To work efficiently, however, it is necessary that the trainees be relatively homogeneous with respect to the abilities required to complete training and that the media of instruction are tailored to these abilities. Such a strategy, thus, ignores individual differences.

McFann notes that Army training has been alleged to fit Strategy I. He points out that Army training is more similar to Strategy II. In this strategy everyone enters together, receives the same instruction, but not all make it through training the first time. Some trainees are recycled and generally receive the same instruction as they received the first time through the program. Thus, the time required to complete training may vary considerable. Finally, graduation under this strategy may be based on achievement of a number of GO/NO-GO (fixed) standards or on the achievement of a minimum post-training evaluation score. In the Army, fixed standards for graduation are generally the case, while in public education performance standards that vary are more often the rule.

In these strategies, a key problem is at what level should instruction be oriented. If it is geared to the low-ability student, the more capable are held back with resultant boredom, poor attitudes, and lack of efficiency of instruction. Instruction geared to high-ability trainees may result in high recycling rates or the graduation of personnel who have failed to completely master the instructional content.

This problem may be avoided if differences in the entry level ability of the trainees are taken into account. In this case, fixed standards are employed and the same curriculum is taught. Instruction is geared to the low-ability trainee. Trainees who can then meet the fixed require-ments are moved through the program as fast as they can meet there standards. For this situation, more instructors are available to assist low-ability students. In this way, the likelihood that all graduates will have mastered the instructional content of the program is maximized.

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Table 3

TRAINING STRATEGIES

Training Strategy	Curriculum	Time to Complete Training	Proficiency Standard Required For Graduation
I	Fixed	Fixed	Variable
II	Fixed	Variable	Fixed or Variable
III	Variable	Fixed	Variable
IV	Variable	Variable	Fixed or Variable

Training Strategies III and IV (see Table 3) take into account individual differences. Strategy III involves a variable curriculum and a fixed amount of training time. In using this strategy, trainees are grouped by ability level or some other factors known to be associated with training success. The instructional approach employed under this strategy is geared to each ability group. Lower level ability groups, given a fixed amount of training time, may be expexred to master less of the total curriculum and achieve lower performance levels. Higher level ability groups are expected, on the other hand, to master most, if not all, of the training curriculum at higher performance levels. Thus, with this strategy the outcome is likely to be a variation in the quality of the trainees produced.

In implementing this strategy, the key is the employment of a selection procedure which places individuals into the proper instructional group. This requires knowledge of a relationship between an ability variable or other factors and training, either acquisition or terminal performance. Using this knowledge, homogeneous training groups are established. Then, instructional techniques appropriate for each homogenous group can be utilized.

A major problem with this approach is with a fixed amount of training time, it is difficult to allow for the possibility of movement of trainees from one group to another. Further, if trainees are catagorized as members of a particular group, individual expectations may develop that can have a negative effect on the trainee performance.

Strategy IV involves both a variable curriculum and a varible amount of training time. Selection procedures are used to match trainees with a trainiag curriculum. The trainee then initiates the course of instruction and proceedes in one of two ways. In the first, the trainee completes successive segements of instruction. To pass from one segement of instruction to the next, the trainee must meet minimum proficiency standards. Graduation is dependent on the successful completion of all instructional segments.

In the second variation, the trainee completes a proficiency test prior to completing instruction. Based on the results of this testing, a specific course of instruction is set-up for the trainee that covers just those areas for which the trainee can not demonstrate adequate proficiency levels. Obviously, this strategy allows for a large amount of trainee-trainer interaction. It also calls for a complex management scheme to provide for the flow of trainees through the training curriculum.

Strategies III and IV are the appropriate training strategies to consider for individualizing BRM instruction as it will be taught in the future. For the reasons discussed previously such individualization must take into account the company as the primary unit of organization for the trainee and the interface of BRM instruction with other basic training activties.

To employ Strategy III for individualized BRM training, the following scheme is suggested. Upon arrival at the training center, trainees are divided into two groups on the basis on one or a combination of demographic or other factors known to be predictive of success in rifle marksmanship training: a low level success group and a high level success group. In this way, groups of trainees, homogenous with respect to their likelihood of success, are created. Next, each group of trainees is assigned to a different training company staffed with instructors trained in the use of instructional techniques appropriate for teaching BRM to trainees with a given likelihood of markmanship success. The curriculum for the low level success group should consist of only the very basic knowledge and skills required to operate and use the M16A1 rifle in combat. The curriculum for the high level success group, on the other hand, should consist not only of the basic knowledges and skills but also of other knowledges and skills that supplement and reinforce the basic skills. For both groups, the amount of time allocated for each phase of training should be the same. Further, this time should be sufficient so that the slowest learners will be able to learn the majority of the knowledges and skills required for the operation and use of the rifle.

Training for the two groups is initiated according to the scheduling requirements of basic training. For the low success group, the training should employ instructional techniques and media that provide for close contact between the trainer and the trainee. Under these conditions, performance errors can be detected early and corrective instruction can be immediately applied.

For the high success group, it may be expected that training will proceed with little need for significant amounts of trainer-trainee contract. Minimal time may be placed on activities designed to present information. Most of the time for a training phase can be directed instead to practive activities that culminate in tests designed to determine how well the trainee is able to perform the tasks addressed during the training phase.

For both training groups, following each training phase, tests should be completed that are designed to indicate if the tasks addressed during the training phase can be performed. All tests completed following a training phase must be completed successfully by all trainees before the next phase of training is begun. Because the content of the training will be different for the low and high success groups, it is likely that the tests for the high success groups will be more difficult and longer. These facts must also be considered in allocating time for instruction and practice activities for these trainees.

Once instruction and practice activities for both groups have been completed, trainees in these groups can complete a final performance evaluation designed to determine how much they have profited from the training. This evaluation should be designed to asses the skills that both groups have been taught.

For the low success group, it should be required that a minimum performance level be achieved only for those tasks for which they received training. For the high success group, it should be required that a minimum performance level be achieved for all tasks tested by the evaluation.

Individualizing BRM training using Strategy III in the manner described above should impact minimally on the management of trainees, since all trainees of a given level of marksmanship success are consolidated within the same training company. The major problem in implementing this approach will be the developement of different instructional plans to accomodate the low and high success trainee group and training the company to implement these plans.

Use of Strategy IV for individualizing BRM training is quite similar to the Strategy III approach. After the trainees have arrived at the training center, they are assigned on the basis of demographic or other factors to low and high marksmanship success group. The low and high groups are then assigned to different training companies as in the Strategy III approach.

For trainees in the low success group, the training is designed to teach only basic rifle marksmanship skills, The time allocated for each phase of training is fixed. Trainees interact closely with training cadre and pass from one phase to the next, only after they successfully complete each preceeding phase. Instructional techniques and media are employed which accomedate a close trainer-trainee interaction. The curressful completion of a training phase is based on the achievement of a mimimum proficiency level on a test designed to measure the trainees' ability to complete the tasks addressed during the training phase. Completion of the total training program is based on achievement of a minimum score on a post-training profiency test completed after all training is finished.

For trainees in the high success group, training is designed to teach basic marksmanship skills, and as well, other skills that supplement and reinforce the basic skills. The time allocated for the total training program is allowed to vary on a trainee by trainee basis. Prior to each training phase, trainees are tested to determine if completion of the training for that phase is necessary. When the training is found to be unnecessary, the trainee is allowed to go on to the next training phase. Under this scheme, some trainees can conceivable by-pass all or most of the planned training. It is likely, however, that this will occur in only a few cases. When trainees are able to by-pass some of the training they can be diverted to other basic training activities or can be allowed to assist the training cadre in the instruction of other trainees in the high success group. Finally, after all trainees have completed those segments of training that are necessary, as a group these trainees complete a post-training proficiency evaluation designed to test the trainees' ability to perform all of the tasks addressed by the complete training program. Successful completion of the evaluation by a trainee should be based on the achievement of a minimum score.

Individualizing BRM training using Strategy IV in the way described above should impact minimally on the management of the trainees in the low success group since there are consolidated in a single training company. Management of the high success group, however, may be a significant problem since some of these personnel may by-pass selected segments of training. Additional problems in using this strategy are the requirements to develop different instructional plans for low and high success trainee groups and the training involved in teaching the company cadre to implement these plans.

SUMMARY

The ARI is currently conducting research to identify improvements and develop cost-effective alternatives for M16A1 rifle marksmanship. Field experimentation has suggested that BRM training is a viable candidate for individualization. To investigate this possibility a review of the educational and training literature was conducted with respect to the individualization of instruction. Additionally, based on the results of this review and relevant considerations for BRM training, strategies for implementing an individualized BRM program were identified and discussed. In this section of the report, the results of the review and the strategies identified for individualizing BRM training are summarized.

THE LITERATURE REVIEW

The literature review identified several approaches to the problem of individualizing training in perceptual-motor skill learning: the abilities approach, the structured learning approach and the discovery learning approach. Additionally, it was found that initial learning experiences, the degree of learner participation in the acquisition process and degree of individual concentration are important factors mediating the acquisition process in skill learning tasks. Finally, it was found that the training strategies employed in skill learning must take into account the three stages that underlie the acquisition process in this type of learning.

In summarizing the findings of the review as they relate to BRM training, the following conclusions were derived.

      o Group based, structured, prescribed and programmed instructional methods should be considered for teaching basic trainees cognitive and/or procedural aspects of BRM training.

      o For those phases of BRM training involving rifle marksmanship practice, guided or procedural learning strategies should be considered for the development of rifle marksmanship skills.

      o BRM training should be combat referenced and threat oriented.

      o A two phase BRM training program should be considered for adoption. The program's first phase would consist of a series of prescribed, programmed learning sequences for knowledge and procedural tasks. This phase would be followed by hands-on, prompted learning sequences for teaching trainees how to hold, sight, aim, and fire on targets in both simple and complex target situations. The precise time split between the phases should be determined on the basis of practical considerations.

TRAINING STRATEGIES FOR AN INDIVIDUALIZED BRM PROGRAM

Prelimarly to the discussion of training strategies for an individualized BRM program, the current BRM training program was discussed and summarized. Next, the relationship of this program to the overall basic training program was addressed and the implications of this relationship for an individualized program were identified. Finally, a brief discussion was presented that summarized the likely nature of BRM training in the future.

In the context of the above considerations, four training strategies were presented and their use discussed. It was noted that only two of the strategies take into account trainee individual differences and are, thus, appropriate strategies for individualizing BRM instruction.

The first of these strategies involves a variable curriculum and a fixed amount of total training time. Trainees are grouped by ability or some other factor known to be associated with training success. Trainees complete instruction and practice that is geared to their particular grouping. If the grouping is in terms of a high likelihood of success and a low likelihood of success, it may be expected that trainees in the low success group will master less total instructional content and achieve lower levels of performance than the high success group during training. This assumes that for a fixed amount of training time, low success trainees will not be able to learn as much as high success trainees. With this strategy, there is likely to be significant variation in the quality of the trainees produced.

The second of the strategies appropriate for individualizing training involves a variable curriculum and variable total training time. Selection procedures are also used to place trainees into groups in terms of their likelihood of training success. Once trainees are placed into a training group, they proceed in one of two ways. In the first approach, trainees complete all phases of instruction. To pass from one phase to the next, they must meet specified minimum proficiency standards. To graduate, all trainees must complete all phases of instruction. Therefore, it may happen in this approach a trainee will complete one or several phases of training more than once.

In the second approach, trainees are tested prior to initiating training to determine if selected segments of instruction may be by-passed. Based on the results of the testing, tailored training programs are prepared for each trainee. As in the first approach for this strategy, trainees must successfully complete each part of their training program in order to graduate from the program.

Finally using these strategies as a basis, two schemes for individualizing BRM instruction were developed and presented. The discussion of these schemes centered on assignment of trainees to low and high training success groups, the nature of the instruction for these groups, the nature of the trainee-trainer relationship during instruction and practice, and the problems inherent in using each of these approaches in the context of basic training.

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